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ABSTRACT

Three studies were made of the implementation of the Australian Science Education Project (ASEP) materials in secondary classes in Victoria, Australia. The materials were designed to facilitate a more individualized approach to the learning of science. The first implementation study sought the perceptions of teachers, the second analyzed student reactions, and the third consisted of a case study of two groups of students using ASEP materials. Teachers reported desirable changes in the way students spent their time but noted increasing problems in performing their teaching tasks. They felt that a more teacher centered role needed to be taken when ASEP materials were used. The studies of student reactions focused on actual time on task and perceptions of the learning environment. A consistent pattern of time use emerged, with fifty-one percent of time spent on task. This is generally accepted as an expected outcome by teachers unless specific steps are taken to increase the proportion of time spent on work-oriented activities. Although there were some positive changes in student perceptions during their use of ASEP materials, there was an overall decrease in their satisfaction with the materials. The quality of student work was clearly seen by teachers as unsatisfactory. While students reported less difficulty with school science when using ASEP materials, teachers expressed concerns about superficial treatment of topics by students. It is concluded that ASEP remains an example of an investment of time and resources on materials development not matched by an investment in subsequent research and development in teacher education and teacher support. (JD)

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The Implementation of an Individualized Curriculum: From Evaluation to Research

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The Implemenation of an Individualized Curriculum:

From Evaluation to Research.

Introduction

This paper examines the results from three studies of the implementation of the Australian Science Education Project (ASEP) materials in junior secondary classes in Victoria, Australia. The materials were designed to facilitate a more individualized approach to the learning of science than existed in most science classrooms. Particular attention is paid to the effects of this emphasis on individualization when the materials were used in schools.

A brief description of the ASEP materials is followed by a summary of the results of three studies of ASEP implementation which focused on aspects of individualization. These results are used to identify some apparent inconsistencies in the responses to the ASEP materials and these are discussed in the remainder of the paper.

The ASEP Materials -- A Description

The term "second generation" has been used to describe science curricula developed in the early 1970's. Zoller and Watson (1974) refer to the tendency to integrate science with social science disciplines, an emphasis on humanistic aspects of science, opportunities for greater teacher and pupil choice, attempts tc cater for individual differences and fostering pupil interest as characteristics of these second generation materials. ASEP materials had all of these characteristics and the summary presented in Table 1 indicates some of the curriculum changes the ASEP developers were concerned with in the design of the materials.

Table 1. Summary of some of the shifts in curriculum ideas reflected in the design of the ASEP materials

CURRICULUM ASPECT	FROM ⟶	TO
FORMAT	TEXTBOOK	MODULE
STRUCTURE	SCOPE & SEQUENCE	CORE AND OPTIONS
OVERALL PURPOSE	SPECIALIZED	GENERAL/INTEGRATION
CONTENT	THEORETICAL	APPLICATION
CHANGE	INNOVATION/CENTRE-PERIPHERY	REVISION
TEACHER ROLE	FIDELITY OF IMPLEMENTATION	MUTUAL ADAPTATION
TEACHER PRIORITY	SUBJECT MATTER	CLASSROOM ORGANIZATION
LEARNING ENVIRONMENT	FORMAL	INFORMAL
STUDENT INVOLVEMENT	TEACHER DIRECTION	INDIVIDUALIZED

Two further characteristics of the ASEP materials indicate an emphasis on the development of materials to allow for independent progress of students or groups of students. Firstly, the materials reflect a project concern for readability issues. A desire to have the written materials partly replace the teacher as organizer of the learning process led to a considerable research effort in aspects of readability prior to finally preparing the materials. Secondly, the materials were organized according to a Piagetian view of cognitive development, an expectation that different activities could be used in a classroom at the same time with students at differing stages of development.

To summarize, the ASEP materials were designed to allow for teachers and/or students to make choices in the science activities undertaken. The materials were also designed to allow for differing student rates of progress through each science unit. This paper describes what happened in classrooms when the ASEP materials were used.

The Implementation of ASEP

The description of the implementation of ASEP which follows is developed from three different approaches to the study of implementation. Each study was carried out during the first two years of ASEP availability.

The perceptions of teachers. A questionnaire survey of science teachers was carried out after the ASEP materials had been available for one school year. As part of a study (Northfield, 1980), science teachers who had used ASEP materials at Grade 7 level (N=72) responded to items relating to the science materials used in the preceding year, the way in which they used ASEP units, their rating of the value of individual ASEP units, problems associated with the use of ASEP materials, a comparison of ASEP units with previously

used science materials and a report on how students were now spending their time in the classroom. In addition, 23 teachers were interviewed on two occasions in a study of implementation of one particular ASEP unit. From this data gathered on teacher perceptions a number of findings related to individualization can be extracted (see Table 2).

Table 2 provides evidence for the impact of ASEP materials on science classes. Teachers report changes in the way students are spending their time (Table 2a) but with increasing problems for their teaching task (Table 2b). The problems indicate the management concerns (Hall and Rutherford, 1976) expected for teachers using an innovation. There was also a consistent teacher response in interviews and open-ended sections of the questionnaire which expressed the need for teachers to gain a greater measure of control over the activities of the classroom. There was a general feeling that a more teacher centered directive role needed to be taken when ASEP materials were used. Yet teachers acknowledged increases in student interest and desirable shifts* in the ways students were spending their time in science lessons.

Information from students. As part of an intensive study of 23** year 7 classrooms completing the ASEP unit "Places for People" (Northfield, 1980), students in each class were asked to record the parts of the unit on which they had spent time at the end of each lesson. An analysis of each student's record provided an indication of the degree of individualization occurring with each class. Three distinct patterns of use of the ASEP unit were identified from the analysis of the student records in each class.

. Wide choice classes (N=5). These classes were characterized by a

*Desirable from a developer's perspective.

**Six classes could not be used in this final analysis--two classes had teacher changes, two teachers integrated the unit with other subject areas and teamed with other teachers while two teachers introduced a wide range of other science activities to supplement the unit.

Table 2. A summary of teacher responses to the ASEP materials (N=72)

a) Student activities in the classroom (percentage of science teachers)

More likely to occur with ASEP materials

Reading science materials (70)
Discussing work in small groups (85)
Discussing work with teacher as individuals or small groups (65)
Doing science experiments (35)

Less likely to occur with ASEP materials

Listening to the teacher talk to the class (55)
Looking up information from other sources (50)
Non-involvement of students in science (40)

b) Problems associated with use of ASEP

Problem areas	Percentage of teachers reporting an increase in the problem with use of ASEP materials
Student boredom when using booklet	53
Storing equipment	50
Student reading difficulties	38
Classroom noise	38
Obtaining equipment	38
Controlling classroom movement	36
Damage to equipment	35
Assessing student progress	30

large number of different activities involving different students/groups at any one time. This pattern was established from the first day of the unit in an ASEP unit with 22 separate activities available. These classes averaged from 7.8 to 9.7 different activities proceeding in any one lesson.

. Less choice classes (N=5). There were fewer activities used in each lesson and analysis of student records revealed a pattern of very few activities in the earlier lessons with an increasing number of activities toward the end of the unit.

. Limited choice classes (N=7). Very few different activities were followed in each lesson and all students tended to work on the same activity at the one time. The materials were used as a resource by teachers as they managed the class as one large group.

A further aspect of the intensive study involved measuring student perceptions of their learning environment using a modified version of the Learning Environment Inventory (Anderson, 1971; Anderson and Walberg, 1974). Nine scales were regarded as important dimensions of the learning environment and a 51 item inventory was completed by students in each class before and after the ASEP materials were used.

This approach allowed for changes in the learning environment to be determined and also how these changes were related to the different ways of organizing classes to complete the unit. The results set out in Table 3 are a summary of a more detailed analysis (Northfield, 1976, 1980).

The results in Table 3 indicate some encouraging changes in student perceptions for the developers of ASEP (an exception would be the overall decrease in student satisfaction). For two of the scales (environmental

Table 3. Changes in student perceptions of school science associated with use of ASEP materials

Inventory scale	Example of an item on that scale	Change in perception over period of use of ASEP unit
Individualization	Pupils can choose to study different science topics that interest them.	Overall increase in individualization.
Environmental suitability	Science lessons are held in a room which allows us to carry out our science activities easily.	Students using ASEP materials in the wide choice classrooms perceived their environment as more suitable than those in limited choice classrooms.
Goal directedness	Each student knows exactly what is expected.	Overall increase due to increases in wide choice and less choice classrooms.
Satisfaction	Students really enjoy science lessons.	Overall decrease in satisfaction.
Difficulty	Only the clever pupils can do the work in science.	Overall decrease in difficulty.
Competitiveness	Students often race to see who can finish first.	Overall decrease in competitiveness.

suitability and goal directedness) the desirable changes were apparently facilitated by allowing a greater diversity of activities to occur in the classroom.

A Case Study of Students Completing One Unit

One insight into the way in which students were spending their time when using an ASEP unit was provided by an ethnographic case study (Suan, 1976). Suan was able to participate as a member of several groups of students completing an ASEP unit*. This study provides a rare example of a description of the student activity in the ASEP approach being followed in two particular classrooms. The results of his case study of the two groups is summarized in Table 4.

There is of course no claim that the two groups in the case studies are representative of how groups of students use the ASEP materials. However, when these results are shown to groups of teachers a great deal of discussion generally ensues. The consistent pattern of time use, with 51% of time spent "on task" (Table 4a), is generally accepted as an expected outcome by teachers unless specific steps are taken to increase the proportion of time spent on work oriented activities.

The results in Table 4b relating to the quality of work performed during the unit provoke a great deal of response when shown to groups of teachers. The quality of work is clearly seen by teachers as unsatisfactory. Group A have completed five drawing activities and four experiments from two sections of the course and only one of the experimental outcomes was regarded as a

*Suan was a youthful Asian post-graduate student. He was introduced to students as an overseas student wanting to know more about ASEP materials by completing a unit. In each case the student group seemed to accept Suan as a group member and he participated in the group by being as unreactive as possible.

Table 4. A case study of two student groups completing the ASEP unit Cells, the units of life

a) Time spent in various activities over the 8 x 60 min. periods

Types of Activity*	Percentage of time spent			
	Group A		Group B	
	Range for 8 periods	Total Time	Range for 8 periods	Total Time
1. Transition-in	5-17	9	5-17	9
Work Oriented				
2. Collecting equipment	0-10	4	0-33	10
3. The activity	0-67	36	3-77	33
4. Reading	0-33	8	0-18	4
5. Discussion	0-11	3	0-22	4
Total Work Oriented	0-80	51	25-90	51
6. Social	0-83	32	0-50	32
7. Transition-out	8	8	8	8

*Scheme for classifying student activities was derived from Gump, P. V., "The Classroom Behavior Setting: Its Nature and Relation to Student Behavior." U.S. Office of Education Co-operative Research Branch Project No. 5-0334. mimeo, 1967.

b) Tasks carried out by the two groups during the course of the unit

		Unit consists of Core section and five options						
		Core	Opt.1	Opt.2	Opt.3	Opt.4	Opt.5	Total
UNIT ACTIVITIES AVAILABLE*	Experiment	2	12	2	4	1	0	21
	Drawing	5	12	0	3	0	0	20
	Writing	0	0	0	8	0	0	8
GROUP A	Experiment	F,F	-	S,NA	-	-	-	4
	Drawing	5	-	-	-	-	-	5
	Writing	0	-	-	-	-	-	0
GROUP B	Experiment	F,NA	F,F,S,F	NA,NA	F	-	-	9
	Drawing	2	0	0	0	0	0	2
	Writing	0	0	0	0	0	0	0

*Copies of the experimental activities carried out by the students are included in the study. The author's rating of the group performance on each activity is noted according to the key:

S = Success

F = Failure (underlying idea not understood)

NA = No attempt (exercise read by not complete)

successful learning experience. Group B attempted 9 experimental activities from 4 sections of the course but again only one was regarded as leading to a successful learning outcome. While it is not expected that all activities should be completed to achieve the objectives of the unit, little satisfaction can be gained from these results and teacher reactions to Table 4b include:

. suggestions that this provides evidence of the likely undesirable outcome of shifting control for learning from teacher to students

. an initial suggestion that the results indicate poor supervision by the teacher in each case. A closer examination of the student work often leads to some moderation of this view as they see the students' notes and diagrams as similar to the work they have seen as teachers

. an indication of the difficulty of monitoring student progress in classrooms where a wide diversity of activities are being followed.

Reviewing the Studies of Implementation

What can be said about the effects of introducting ASEP materials into science classrooms after examining the results of three different approaches to studying implementation? The remainder of this paper will concentrate on two apparent inconsistencies in the findings presented.

In beginning to interpret these inconsistencies there is a desire to generate discussion and tentative hypotheses about the use of more individualized curricula. By using the results of three approaches to studying implementation as the starting point it is hoped that such hypotheses can be "grounded" (Glaser and Strauss, 1967) in some recent experience with curriculum materials.

The apparent inconsistencies identified in the remainder of the paper represent only a few of the issues that might receive attention and the reader is invited to identify and develop interpretations for other issues.

Issue No. 1

Students report a clear understanding of the purposes of school science especially in situations where classrooms are organized to allow more independent and group work (see Table 3--scale goal directedness). On the other hand teachers generally express concern for lack of control and student confusion, with boredom and reading difficulties emerging as greater problems (Table 2b).

Two teacher quotes give some idea of a widespread feeling among teachers that a greater degree of curriculum structure and teacher control was required than implied in the design of the materials.

"The children love doing the experiments but will not read the booklets properly and also have to be almost forced to write answers in the record books. The teacher must do far more talking and explaining than should be necessary."

"Some students were hopeless in trying to organize their time. Actually it is good that they do have the chance to organize the time, but it appears to fall by the wayside when their first choices have been completed. This is perhaps where something a little more structured could be an advantage."

The teacher response is not unexpected and the need for greater control of learning and more structure in the materials can be regarded as a result of unfamiliarity with the materials and concern for management issues in the early stages. The increase in goal directedness reported by the students (especially in classrooms where teachers facilitated a greater diversity of student activities) appears to contradict teacher views of what is required.

One explanation might be that students and teachers perceive different purposes for school science with the ASEP materials fostering some student purposes but not satisfying some teacher purposes. Research in this area of possible mismatching of student and teacher intentions for science would seem to be justified and some work in this area has commenced (Tasker, 1980). A related interpretation is that a teacher's major purposes for a class are independent of the subject being taught and concern orderly management of students and ensuring some degree of mastery of what is taught (Westbury, 1973). The results in Table 4 are likely to increase teacher concern about the latter purpose being achieved with the ASEP materials.

Issue 2

Students report less difficulty with school science when using ASEP materials (Table 3) but in interviews teachers expressed concerns about superficial treatment of topics by students and the results in Table 4 would seem to confirm these doubts. The ASEP project left the issue of ensuring some degree of mastery or "quality control" to the individual teacher. Twelve out of seventeen teachers responded by treating the class as one group for at least a large part of the unit. There were suggestions that discussion questions should be inserted throughout the materials to develop ideas or short tests be developed to assist in monitoring progress. However, little research and development has been attempted along these lines and there has been limited dissemination of the discussion questions and tests developed by individual teachers. So ASEP remains a further example of an investment in time and resources on materials development not matched by an investment in subsequent research and development in teacher education and teacher support.

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